Site New Bedford
Doc 17.8.6

62217

A Report on the PCB Data Needs and Dredge Techniques for the Acushnet River-New Bedford Harbor Area

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June 1981

Under the tasks adopted by the 1981 State/EPA Agreement, this report fulfills the Massachusetts Division of Water Pollution Control's requirement outlined in Issue 10, Objective II.C. As identified by the agreement, there existed a need to catalog the polychlorinated biphenyl (PCB) distribution in the Acushnet River-New Bedford Harbor area. A review of the literature for applicable dredge material technologies was also needed if subsequent clean-up of the PCB contamination is attempted.

PCB compounds are a type of chlorinated hydrocarbon, with a different molecular structure since chlorine has been substituted for hydrogen. Over 100 varieties of PCB have been produced since 1929, with major application in electrical capacitors and transformers. Due to the apparent correlation between PCB and various maladies, including carcinogenic effects, their production has been banned in the United States since 1972. Subsequent use of PCB has also been banned since 1976.

In the New Bedford area, Aerovox Industries and Cornell Dubilier Electric Corporation both used PCB in the production of capacitors. Best determinations indicate the PCB variety Aroclor 1242 was used in the greatest quantity. Aroclor 1016 replaced 1242 in 1971 since it was believed to be less toxic. Aroclors 1252 and 1254 were also used in small quantities.

Since 1976, when a problem was first identified, bottom sediments samples were taken from the Acushnet River and various New Bedford Harbor locations. A number of agencies and laboratories were involved in the collection and analysis of these samples for PCB. The results of these analyses are depicted in Table 1 and Figure 1.

It can be generally stated that the results are not comparable because of the various expertise, techniques, and laboratories that were involved. The determination of PCB concentrations is a precise technique, and because of this the variables mentioned above create deviations of results. In addition, it has been suggested by Dr. John Farrington of Woods Hole Oceanographic Institute and Dr. Jacek K. Sulanowski of Bridgewater State College that the available data underestimates PCB sediment concentrations. As is shown by Table 2, results from WHOI versus other historic data differ by a factor of 3 to 4 times. The reason appears to stem from the fact that the historic data reports Aroclor 1254, while the WHOI reports total PCB by including Aroclor 1016 and 1242. The fact that Cornell Dubilier Electric Corporation used 3.1 million pounds of Aroclor 1016 from 1971 to 1975 versus 24,000 pounds of Aroclor 1254 supports this contention (Santos 1978).

Other flaws in the PCB sediment data are apparent. Exact locations of the sample stations are unknown, many laboratories have analyzed the samples, total PCB Aroclors have not been reported, and collection of samples had not been uniform or precise. The PCB sediment sample needs are evident. There is a need for a well planned sampling program conducted by one laboratory experienced in PCB analyses that specifically identifies areas of high PCB concentrations or hot spots and stratification of greatest concentration. Areas of known and suspected discharges should be sampled as should depositional areas within the river-harbor system. Locations such as Clarkes Cove, West Island, and the Fairhaven Wastewater Treatment discharge should be included in the survey to help identify PCB distributions.

The dredging needs are also apparent. While the federal navigation channel, maintained by the U.S. Army Corps of Engineers does not need frequent dredging (D. Sullivan, personal communication), expansion and development is anticipated for the North and South Terminals (Tibbetts Engineering, 1978). The proposed New Bedford-Fairhaven bridge will also require dredging in certain areas.

There is also a need to investigate the feasibility of dredging the PCB contaminated sediments for the purpose of cleaning the area. This would serve to lower the concentrations of PCB in the ecosystem, would re-open areas not presently open for fishing or shellfishing, and would remove a potentially dangerous pollution source from migrating to Buzzards Bay.

Dredging PCB contaminated sediments would re-suspend PCB in the water column, allowing it to become more available for uptake by aquatic organisms. Therefore, special dredging equipment or techniques may need to be employed. Special equipment such as the Oozer or Pneuma dredges were investigated. Information of this equipment was made available through a joint United States-Japan conference on the management of toxic bottom sediments (U.S.E.P.A., 1977). A conventional hydraulic dredge pumps bottom sediments by way of a pipeline to a disposal site, or into hoppers aboard a vessel. The slurry created is typically 80% water and 20% sediments. The Oozer and Pneuma dredges also remove material via a suction pipeline, but because of different pumps, the slurry is 20% water and 80% sediments. This results in less turbidity at the dredge site, less release of sediment-based chemicals, less area required for disposal, and less effluent from the disposal area.

However, the efficiency of the Oozer and Pneuma is dependent upon the creation of a hydrostatic head. The creation of this head requires water depths of 30 ft. to 40 ft., and is most efficient in 100 ft. of water. Unfortunately, most water depths in the Acushnet River-New Bedford Harbor area do not exceed 20 ft., other than within the federally maintained navigation channel. Therefore, it does not appear feasible to use this equipment.

The more conventional types of dredge equipment can be put into two categories, mechanical dredges and hydraulic dredges. Mechanical dredges utilize steam shovel type buckets and remove bottom material by shearing forces. The material is then placed into barges and towed to a disposal area, most often an open water site. Disadvantages of using mechanical equipment include increased cost due to double handling, and need for an open water site. Use of an open water site is essentially ruled out due to the Marine Protection Research and Sanctuaries Act and the Clean Water Act. These Acts, as well as the implementation of the London Ocean Dumping Convention limits ocean dumping of materials adversely affecting the marine environment, or human health, welfare, or amenities. Also, dredged material containing PCB concentrations of 50 ppm or greater must be disposed in an approved incinerator, a secure chemical waste landfill, or in a manner approved by the appropriate EPA Regional Administrator.

Hydraulic dredges remove material by suction of water and sediments through a pipeline with disposal at an adjacent site or into hoppers on the dredge vessel. If a hopper dredge with pump-out capabilities is used, then the disposal area is not limited by pipeline length. The handling of a slurry containing PCB will require special dewatering techniques. Settling basins and/or flocculants would need to be employed to restrict or limit the release of PCB back to the receiving water. A technique has also been developed in Japan where pollutants are locked into the dredge material, solidifying the disposed dredged material within a few days (Wooton, 1980).

The U.S. Army Corps of Engineers are also experimenting with a modified dustpan type dredge. Planned uses are for areas with high concentrations of toxic materials. A experimental dredge operation is planned for the summer of 1981 in the James River where Kepone wastes have closed the area to fishing and shellfishing. Additional information may be obtained from Mr. W.R. Murden, U.S. Army Corps of Engineers, Dredging Division, Fort Belvoir, Virginia.

Presently, the Massachusetts Division of Water Pollution Control has contracted Malcolm Pirnie, Inc., Consulting Environmental Engineers to assemble all the existing PCB data relative to New Bedford Harbor. Aquatic biota, water, and air data, in addition to sediment data have been compiled. Included in the contract is the task to outline various methods and costs for the clean-up of Acushnet River-New Bedford Harbor.

Malcolm Pirnie has had experience in dealing with the problems associated with PCB contaminated areas. Recently they were involved with identifying the distribution of PCB in the upper Hudson River. In addition, they developed a program for the clean-up of hot-spot areas within the river (Malcolm Pirnie, 1980).

In summary, in order to properly identify the extent of PCB contamination in The Acushnet River-New Bedford area, a sediment sampling probram should be established. Areas of known or suspected discharges should be sampled for total PCB (Aroclors 1012, 1242, 1252, 1254) at various depths. This will allow identification of areas "hot-spot" concentrations. In addition, serious consideration should be given to the analysis of polychlorinated dibenzofurans (PCDF) to determine if an association exists between PCB and this compound. An unresolved question involves the relative toxicity contributions of both PCB and PCDF and the presence of PCDF in the PCB's found in the NewBedford area (Santos, 1981).

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Table 1.

PCB Bottom Sediment Analysis, Acushnet River, New Bedford Harbor
Reported as parts per million, dry weight, unless noted otherwise

Source	Date	Station	Location	PCB concentration (ppm)
Tibbetts Engineering	4-3-80	S-1	Fairhaven Marine	1.1 (A1016) 2.1 (A1254)
		S-2		2.1 (A1016) 3.3 (A1254)
		S-3		0.31 (A1016) 0.84 (A1254)
W.H.O.I.	6-73	AS-2	Outer Harbor	8.4 (A1254)
	6-79	AS-3	Outer Harbor	0.2 (A1016) 0.3 (A1254)
	1980	Ast23 Sta 67	Outer Harbor	(0-4cm) 11.58 (A1016) 3.20 (A1254)
	1980	NB 84SC5	Inner Harbor	(0-2cm) 126.58 (A1016) 48.55 (A1254)
				(2-4cm) 194.71 (A1016) 65.23 (A1254)
				(4-6cm) 202.86 (A1016) 72.55 (A1254)
				(6-8cm) 146.90 (A1016) 46.30 (A1254)
				(14-16cm) 75.52 (A1016) 28.10 (A1254)
				(20-22cm) 27.56 (A1016) 9.67 (A1254)
		Ast28 Sta 84	Inner Harbor	(0-4cm) 104.69 (A1016) 25.68 (A1254)
				(4-8cm) 137.98 (A1016) 41.43 (A1254)
				(0-4REEX) 0.72 (A1016) 0.47 (A1254)
Corps of Engineers	1976	KE-14	Outer Harbor	12.49 (total PCB)
Camp, Dresser, McKee	1979	106P-S1	Outer Harbor	Not Detectable (A1242)

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)
Camp, Dresser, McKee	1979	106P-S2	Outer Harbor	Not Detectable (A1242)
		107P-S1		8.75 (A1254)
		107P-S2		27.0 (A1254)
		108P-S1		Not Detectable (A1221)
		108P-S2		Not Detectable (A1221)
		109P-S1		Not Detectable (A1232)
		109P-S2		Not Detectable (A1232)
		110P-S1		Not Detectable (A1248)
		110P-S2		Not Detectable (A1248)
		111P-S1		Not Detectable (A1260)
		111P-S2		Not Detectable (A1260)
		112P-S1		Not Detectable (A1016)
		112P-S2		Not Detectable (A1016)
		S1		8.75
		S2		27.0
		S8		Not Detectable
		S9		Not Detectable
		S10		0.3

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)
Camp, Dresser, McKee	1979	S11	Outer Harbor	0.2
		S12		0.2
New England Aquarium	5-73	1	Buzzards Bay	0.032
		2		0.113
		3		0.034
		4		0.274
		5		0.543
		6		0.226
		7		0.406
		8		0.077
		9		0.201
		10		0.175
		11		0.222
		12		0.242
		13		0.072
		14		0.079
Cat Cove/E.P.A.	5-10-76	ARS-10	Acushnet River	N.R./620.0 (A1254)
		NBS-4		N.R./143.0 (A1254)
		NBS-5		N.R./1.9 (A1254)

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)
Cat Cove/E.P.A.	5-10-76	NBS-6	Outer Harbor	N.R./0.5 (A1254)
	9-23-76	H/(NBS-1)	Acushnet River	85.0/47.4 (A1254)
		NN/(FS-1)		88.0/74.8 (A1254)
		J/(NBS-2)		17.7/61.3 (A1254)
		MM/(FS-2)		23.0/21.5 (A1254)
		K/(NBS-3)	Outer Harbor	0.5/78.4 (A1254)
		LL/(FS-3)		N.R./4.1 (A1254)
		JJ/(FS-4)		0.20/0.3 (A1254)
Lawrence Experiment Station	5-78/ 9-79	1	Inner and Outer Harbors (0-4")	7.4/39.7 (A1254)
		1	(4-8")	10.4/25.9 (A1254)
		1A	(0-3")	N.D./72.7 (A1254)
		1A	(3-6")	N.D./0.1 (A1254)
		2	(0-3")	1.9/3.2 (A1254)
		2	(3-6")	3.9/N.R (A1254)
		3	(0-3")	2.5/11.8 (A1254)
		3	(3-6")	4.7/41.5 (A1254)
		4	(0-3")	6.3/67.4 (A1254)
		4	(3-6")	2.9/1.4 (A1254)
		5	(0-4")	3.4/N.R (A1254)

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)	
Lawrence Experiment Station	5-78/ 9-79	5	Inner and Outer Harbors (4-8")	8.3/N.R	(A1254)
		6	(0-4")	4.2/43.1	(A1254)
		6	(4-8")	5.1/0.2	(A1254)
		7	(0-3")	20.4/19.6	(A1254)
		7	(3-6")	31.6/11.6	(A1254)
		8	(0-3")	19.9/11.6	(A1254)
		8	(3-6"/ 3-7")	14.3/4.4	(A1254)
		9	(0-4")	13.1/7.5	(A1254)
		9	(4-7")	13.7/11.9	(A1254)
		9	(7-10")	29.8/N.R	(A1254)
		10	(0-4"/ 0-3")	2.4/7.9	(A1254)
		10	(3-6")	N.R./3.2	(A1254)
		11	(0-3")	4.9/N.R.	(A1254)
		11	(3-6")	4.0/N.R.	(A1254)
		12	(0-3")	3.3/0.3	(A1254)
		12	(3-6")	7.4/1.1	(A1254)
		12A	(0-4")	6.8/N.R.	(A1254)
		12A	(4-8")	12.7/N.R.	(A1254)

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)	
Lawrence Experiment Station	5-78/ 9-79	13	Inner and Outer Harbors (0-5"/0-3")	12.0/1.0	(A1254)
		13	(5-8"/3-6")	5.2/4.3	(A1254)
		13	(6-9")	N.R./4.8	(A1254)
		14	(0-4")	1.8/2.0	(A1254)
		14	(4-6"/0-2")	3.6/2.0	(A1254)
		14	(2-5")	N.R./1.6	(A1254)
		14	(5-8")	N.R./9.6	(A1254)
		15	(0-3")	7.1/0.8	(A1254)
		15	(3-6")	7.2/0.1	(A1254)
		15	(6-10")	N.R./0.6	(A1254)
		16	(0-3")	9.7/N.R.	(A1254)
		16	(5-10")	4.3/N.R.	(A1254)
		17	(0-3")	7.9/0.3	(A1254)
		19	(0-2")	7.4/0.9	(A1254)
		19	(2-8")	N.R./0.5	(A1254)
		20	(0-2")	5.2/2.4	(A1254)
		20	(2-5")	N.R./4.1	(A1254)
		22	(0-1.5")	7.2/3.3	(A1254)

Table 1. continued

Source	Date	Station	Location	PCB concentration (ppm)	
Lawrence Experiment Station	5-78/ 9-79	22A	Inner and Outer Harbor (0-4"/0-3")	6.8/43.6	(A1254)
		22A	(4-8")	8.4/N.R.	(A1254)
		23	(0-4")	0.4/N.R.	(A1254)

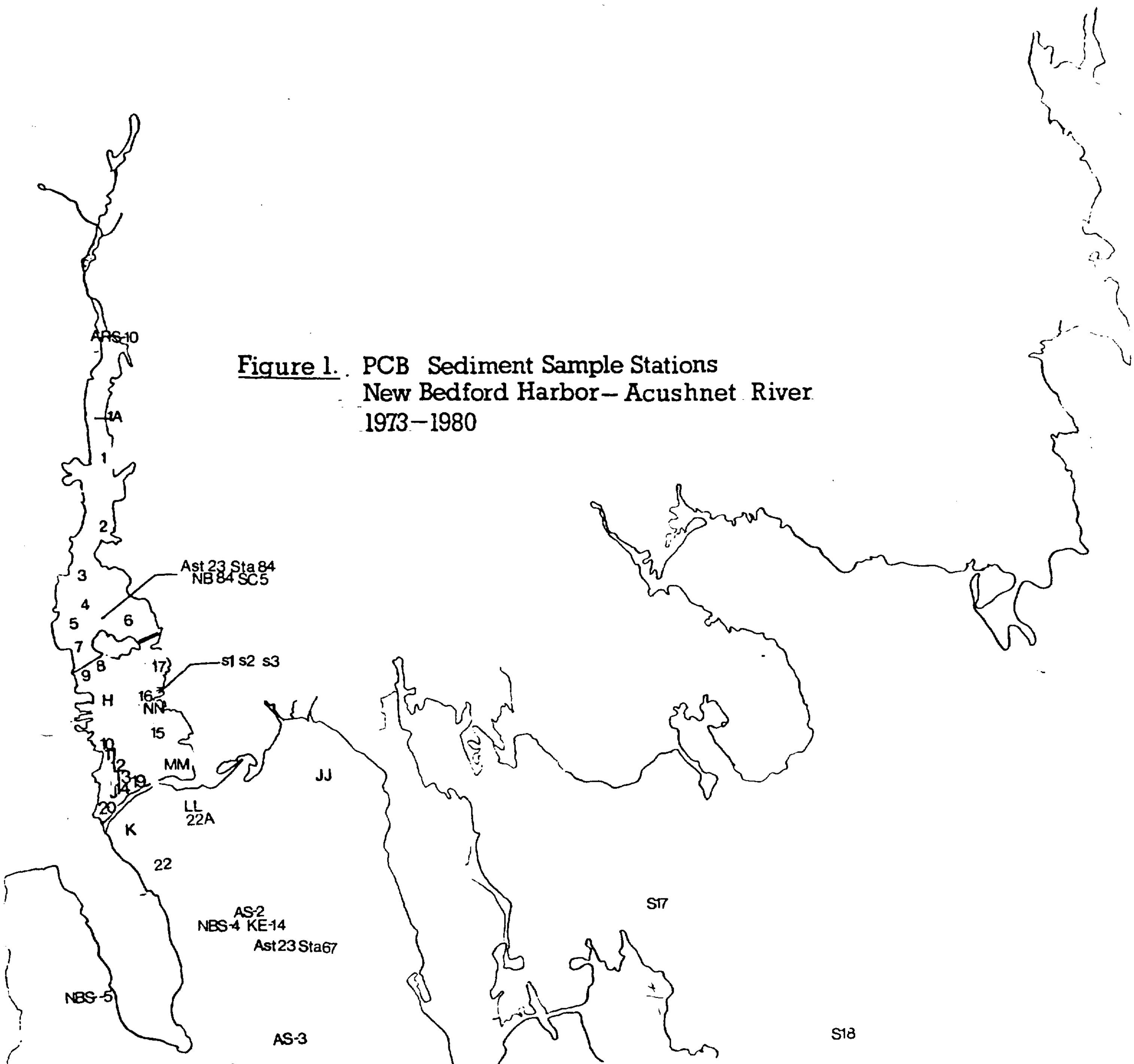

Figure 1. PCB Sediment Sample Stations
New Bedford Harbor – Acushnet River
1973 – 1980

TABLE 2.

Data compararison of W.H.O.I. (total PCB) results versus average Federal and State (Aroclor 1254) results reported as ppm dry weight

Laboratory		Aroclor 1254	Aroclor 1242	Total PCB
E.P.A.		51.25	----	
Cat Cove		53.50	----	
Lawrence Experiment Station		7.80	----	
Average of above		20.52	----	
W.H.O.I.	(0-10cm)	49.99	151.78	201.77
	(10-20cm)	28.10	75.52	103.62
	(20-50cm)	9.67	27.56	37.23